Unit 04 – Programming

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4.21 Learning Aim A – Principles of Logic Applied to Program Design

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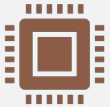
Learning Objectives

To understand the various principles of logic.

To be able to solve problems using logic principles.



To be able to explain how to apply these principles to program design.

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4.21.1 Mathematical Logic

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What is Logic?

Logic can be defined as a process used for arriving at a conclusion.

The basis of logic is a proposition, or a statement.

The proposition is either TRUE or FALSE.

The Conclusion is also either TRUE or FALSE.

These are **BOOLEAN** conditions.

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Logic and Programming

- All programs have to make decisions.
- The decisions that they make will be based on conditions.
- These conditions can be **TRUE** or **FALSE**.
- For example, a simple password validator will run different code if a password is less than 8 characters.
- If that condition is **TRUE** – show an error.
- If it is **FALSE**, log in the user.

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What is Mathematical Logic?

This uses the concept of **INFERENCE**.

An Inference is a conclusion based on a **PREMISE**.

A Premise is a statement that is either **TRUE** or **FALSE**.

You can have as many premises as you like.

However, they need to be correct to draw a proper inference.

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TRUE INFERENCE.

STATEMENT TYPE	STATEMENT	RESULT
PREMISE	People can breathe.	TRUE
PREMISE	Students are a type of person	TRUE
INFERENCE	Students can breathe.	TRUE

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What are Fallacies?

A fallacy occurs when one or more premise is FALSE.

It is possible to get a fallacy when one or more premise is TRUE.

In this case, the premises do not have enough information for the inference to be TRUE.

Your starting premise is not complete.

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FALSE INFERENCE - FALLACY

STATEMENT TYPE	STATEMENT	RESULT
PREMISE	People can run.	TRUE
PREMISE	Teachers are not people.	**FALSE**
INFERENCE	Teachers cannot run.	FALSE

This premise is NOT CORRECT

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FALSE INFERENCE Where all Premises are TRUE.

STATEMENT TYPE	STATEMENT	RESULT
PREMISE	The Moon is round.	TRUE
PREMISE	A Basketball is round.	TRUE
INFERENCE	The Moon is a Basketball.	FALSE

TRUE

TRUE

This is not right!

The Premises do not have enough information, or you do not have enough Premises

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What is Iteration?

This is when a procedure is applied to the result of a previous application.

For example, looping through an eCommerce System shopping cart.

You multiply the number of items by the price to get the Item Total.

But then you add the Item Totals up to get the Final Total.

This means that the output of the previous application is the input of the new application.

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Iteration Example

ITEM	PRICE
Batteries	£4.99
Pens	£1.99
Ruler	£3.99

	Quantity		TOTAL
X	2	=	£9.98
X	1	=	£1.99
X	3	=	£.2.97
X	1	=	£3.99

THE PREVIOUS APPLICATION WILL CREATE THE COST FOR EACH INDIVIDUAL ITEM

GRAND TOTAL
9.98
£11.97
£14.94
£18.93

FINAL TOTAL
£18.93

Here we iterate through the item cost, adding them up

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Iteration and Recursion

Recursive logic is when you get a function to call itself.

This means that you perform the same operations again and again.

You would usually do this on some form of list or sequence.

This is another form of iterative logic.

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Iteration and Program Design

- When you spot an iteration...
- This means you **MUST** be using a LOOP.
- It could be a For loop, While or Do While.
- This would be up to you to decide..
- The point is that the **LOGIC** is now starting to influence your **DESIGN**.
- Your program code **MUST** contain a **LOOP**!

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CLASS TASK 4.21.1 – Mathematical Logic

Individually, or in pairs:

Attempt all questions in your worksheet.

Discuss your answers with the class.

<u>TIME ALLOWED: 10 minutes</u>

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Self-Check: Lesson Review

- Can I explain Mathematical Logic?
- Can I explain Completeness Logic?
- Can I explain Propositional Logic?
- Can I create and use Sets and Truth Tables?
- Can I explain how these are used in Program Design?

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Further Reading

Websites

https://courses.lumenlearning.com/math4libarts/chapter/truth-tables-and-analyzing-arguments-examples/

https://en.wikibooks.org/wiki/A-level_Computing/AQA/Paper_2/Fundamentals_of_computer_systems/Simplifying_boolean_equations

https://isaaccomputerscience.org/concepts/sys_bool_table_for_circuit

https://www.tutorialspoint.com/discrete_mathematics/discrete_mathematics_sets.htm

Videos

https://www.youtube.com/watch?v=BnB2m1nXZ84

https://www.youtube.com/watch?v=rnZqSkpVtJo

https://www.youtube.com/watch?v=xZELQc11ACY

https://www.youtube.com/watch?v=qV4htTfow-E

Textbook: pp 248 - 249

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